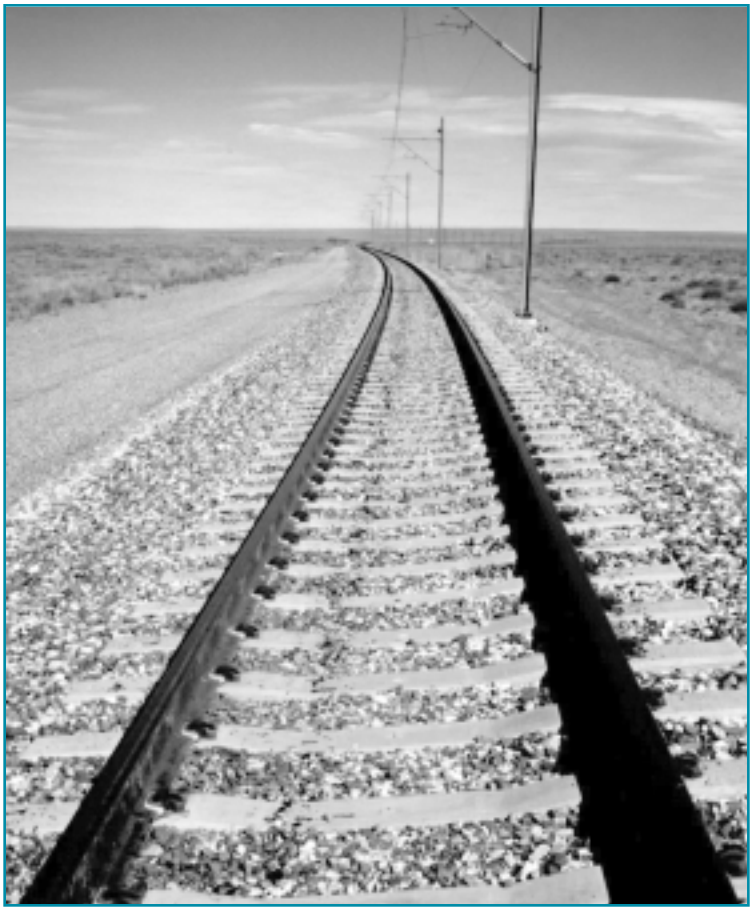
RESEARCH AND DEVELOPMENT FACILITIES AND TEST EQUIPMENT



TEST FACILITIES

SUMMARY

The anticipation of the introduction of new, high-speed trains (150 mph) in the United States operating environment brings with it the need for verification testing before these trains can be placed into revenue service. Tests will be conducted to verify the performance of their mechanical and electrical systems, determine ride quality, examine the system durability, and ensure that all safety features operate as designed as well as other important factors. A safe and efficient location is needed to accomplish this task and detailed test plans must be developed and implemented.

RALES Cab and Motion Base

Development of a safe and efficient high-speed rail system requires a dedicated testing facility and comprehensive testing programs. As new and innovative ideas and products are developed, testing will be undertaken to analyze and evaluate their worthiness.

The Department of Transportation's Transportation Technology Center (TTC) site includes 48 miles of railroad track devoted to testing all types of rolling stock, track components, signal, and safety devices. These tracks are used for track structure and vehicle performance testing – track and service worthiness, life-cycle and component reliability, and ride comfort. The TTC also has several one-of-a-kind laboratory test facilities used for evaluating vehicle dynamics and structural characteristics.

The Research and Locomotive Evaluator Simulator (RALES) facility is located on the campus of the Illinois Institute of Technology (IIT) in Chicago, and is housed within the ITT Research Institute. It comprises a complete locomotive cab (with the industry-standard control stand) mounted on a motion-simulation base. RALES provides a high-fidelity simulation of the in-cab experience of a locomotive engineer, including a projected display of real-world track (originally from 16mm movie film); an out-the-side window view of the cross ties (used by engineers to judge very low speeds); and a sound system that generates engine, brake and track noises.

The RALES facility became operational in 1984 and was based on human factors requirements developed by the FRA. An extensive upgrade was completed in 1994 that replaced the film projector with laser-disc video as well as new computer hardware. In its present configuration, RALES is limited to simulation of trains operating at 80 miles per hour, or less.

RALES Control Room

The FRA maintains a significant stock of equipment, including two FRA-owned railroad vehicles, T-6 and T-10, that are used to support track research and safety inspections. These vehicles were developed under the FRA track research program and are the product of instrumentation and data processing advancements that are uniquely applicable to the railroad environment. In the past, the FRA Office of Research and Development, has operated numerous research vehicles to develop technologies pursuant to its mission, particularly for track inspection and rail flaw detection, and for collecting data for vehicle/track interaction studies.

T-6 is the only remaining operational FRA research vehicle currently used to support the Gage Restraint Measurement System (GRMS) consists. The T-6 was built as a hospital car in the 1950s and began its R&D service as a special test vehicle used in track geometry and safety enforcement until the mid-1970s. It was decommissioned for a number of years, and then reactivated in the mid-1980s as the developmental test bed for the GRMS. The T-6 was also used for developing rail flaw detection systems; collecting track and vehicle data in support of track strength measurements, collecting data used in vehicle dynamics analysis and derailment studies; and collecting data on vehicle track interaction (instrumented wheels).

Currently, the T-6 is used to support GRMS testing activities and functions - in a limited way, because of its age - as a research platform for any additional over-the-road test requirements. Future work scheduled for T-6 will include collecting over-the-road data and evaluating the track analyzer, acting as a test platform to evaluate software and hardware for data alignment procedures tests, and providing support as a data recording vehicle, or loading vehicle, for track stiffness measurements.

RAILROAD TEST TRACK UPGRADE

RESEARCH STATUS

The TTC is operated by the Association of American Railroads (AAR) Transportation Technology Center, Inc. (TTCI), a wholly-owned subsidiary, of and under a care, custody, and control contract with the FRA. It consists of a variety of test tracks and facilities including a 13.5-mile railroad test track (RTT). The National Railroad Passenger Corporation (Amtrak) and the Florida DOT are planning to operate trains at speeds of 150 and 200 mph, respectively. This presented a need for a test facility to evaluate safe operations/performance requirements before these high-speed trains were placed into revenue service.

Installing New Rail in the RTT

In July 1993, the FRA initiated work to upgrade the RTT to allow for a broader range of testing variables. The Volpe Center and Parsons, Brinckerhoff, Quade & Douglas (PBQD) supported the FRA in this effort. Based on the RTT condition study, Amtrak's high-speed operational needs and funding considerations, an RTT upgrade program was developed. The modified track configuration will permit evaluation of the safety, performance, and reliability of prototype high-speed passenger equipment at speeds up to 165 mph. The program was overseen by a working group from the FRA, AAR, Amtrak, the Volpe Center, and PBQD with financial and technical support in partnership with the private sector.

At the start of the upgrade, the RTT consisted of 20-year-old, 13.5 miles of closed loop track of both jointed and continuously welded rail with conventional cut spikes and softwood ties on slag ballast. The loop consisted of four 50-minute right-hand curves ranging in length from 1500 to 15,900 feet, a 50-minute reverse curve with a tangent distance of 100 feet between the curves, and spiral length ranging from 600 to 2,306 feet. With the combination of curves and spirals, it is possible to determine equipment ride quality and maximum force levels developed at the wheel/rail interface over a range of geometric conditions. The existing Style 5 catenary was supported and registered by a single pole and catenary support structure with a maximum span length of 210 feet. The tension in the conductors was maintained by movable balance weights at each end of the catenary section. Both the track structure and the catenary showed signs of wear, which was expected, since they have been in use since the 1970s.

Improvements to the RTT were divided into two phases and began with realignment of a reverse curve from 50' to 1°15'. This would allow for operation at greater cant deficiencies and a longer tangent distance between two curves. The existing jointed rail was cropped and welded and turnouts were either eliminated or repaired. The worn or

Installing Concrete Ties

damaged catenary part was repaired and two carrier wire phase breaks were installed. The second phase, conducted in 1997, consisted of replacing the soft wood ties with concrete ties except for a wood tie section consisting of 800 feet of the existing soft-wood ties with cut spikes, 850 feet of existing soft-wood ties with an elastic fastening system, 2,015 feet of hardwood with cut spikes, and 7,744 feet of hardwood ties with elastic fastening system. The ballast was undercut and granite ballast was added and the track was surfaced and aligned.

KEY FINDINGS

With the completed upgrade and rehabilitation of the RTT, the United States has the only dedicated electrified test track in the world that can accommodate high-speed (165 mph) testing. This facility will be able to support Amtrak and other high-speed agencies well into the future.

FUTURE RESEARCH

The final improvement to the RTT will be the addition of a broken rail/open switch point detection system to ensure faults are identified and appropriate hazard train protection is achieved. This system should be fully operational prior to the initial testing of High-Speed Amtrak trainsets in the late fall of 1998.

AMTRAK HIGH-SPEED TRAINSETS

Amtrak is purchasing 12 high-speed trainsets with an option for 6 more for use in the Northeast Corridor. These trains will be electric-powered.

RESEARCH STATUS

Some of the tests which will be conducted on this new trainset will be high-speed stability, high-cant deficiency, power consumption/power draw, pantograph uplift force, phase break operation, regenerative braking performance, harmonic generation, propulsion and braking, and a 20,000-mile duration test.

KEY FINDINGS

Research is yet to be performed.

FUTURE RESEARCH

Mechanical acceptance, safety, and endurance tests will be run on the first prototype trainset beginning with contractor testing in late fall of 1998, and FRA/Amtrak acceptance testing in early 1999.